Solid State UV Detectors

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Future NASA UV astrophysics missions are influenced by the objectives of the Origins and SEU themes of NASA. Since telescope aperture area is unlikely to grow by more than a factor of ~6 in the next two decades, in order for missions beyond HST and GALEX to result in major new scientific impacts, they will require significant detector advances, particularly in quantum efficiency, resolution, and number of pixels.

The current UV detection technology can be classified into two major categories: 1. Solid-state devices based on silicon or wide bandgap semiconductors and 2. A combination of photoemissive device, i.e., photocathode, a gain component, and an electron detector. Electron bombarded CCDs (EBCCDs) and microchannel plates (MCPs) are in this category.

An immense investment has been made in silicon visible imagers in order to produce detectors with very low noise, low dark current, and very large imager formats. In addition, new techniques such as lateral gain CCDs and low noise CMOS sensors are being developed so that silicon sensors continue to improve and become viable for photon counting applications. High purity silicon detectors either in hybrid or monolithic format are also used for energy-resolved measurements. To achieve the highest UV/optical quantum efficiency in all of these silicon detectors independent of the readout scheme, they must be back-illuminated and properly passivated.

Wide bandgap materials such as gallium nitride (GaN), silicon carbide and even diamond are intrinsically solar blind and are being formed into UV detector arrays as well as UV photocathodes. Usually an array of diodes is made and is hybridized to a CMOS readout. Additionally, monolithic imagers with transistors made from the host or substrate material exist at least in concept. These materials offer the promise of direct solar-blind UV imagers and research into their development is important. Further investment is necessary before imagers in these new materials can provide performance equivalent to silicon imagers.

In this talk, we will discuss silicon-based UV/optical detector technology, quantum efficiency enhancement, as well as wide bandgap material-based UV detector technology. In the wide bandgap category, we will focus on detectors based on GaN and its alloys as well as photocathodes based on this class of material.